Nature and Properties of Waves

PS-6 The student will demonstrate an understanding of the nature and properties of mechanical and electromagnetic waves.

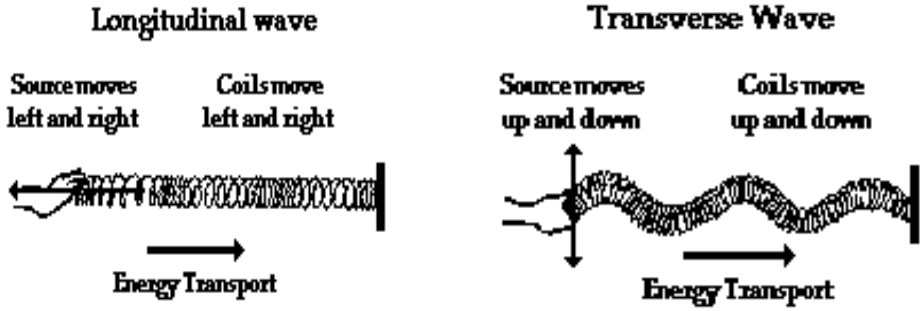
PS-7.1 Illustrate ways that the energy of waves is transferred by interaction with matter (including transverse and longitudinal /compressional waves).
Taxonomy Level: 2.2-B Understand Conceptual Knowledge

Key Concepts:
Wave, Transverse wave, Longitudinal/Compressional wave
Medium
Energy transfer

Previous/Future knowledge: In 8th grade students recalled that waves transmit energy but not matter (8-6.1). In Physical Science students will give examples of waves transferring energy without transferring matter through transverse and longitudinal/compressional waves.

It is essential for students to
- Understand that a wave is a repeating disturbance that transfers energy through matter or space.
  - Wave motion always transfers energy, but not matter from one place to another.
  - When a wave moves through matter, the matter is disturbed so that it moves back and forth, but after the wave passes, the matter will be in about the same position that it was before the wave passed.
- Give general examples of various waves, illustrating, with diagrams or descriptions, the direction of the disturbance and the motion of the particles of the medium in each. Each illustration should:
  - Describe the energy (light, sound, mechanical disturbance, etc);
  - Describe the direction and the path that the energy takes;
  - Identify the medium, if any;
  - Describe the direction that the particles of the medium are disturbed as the wave passes;
  - Describe the position of the particles of the medium before and after the wave passes.

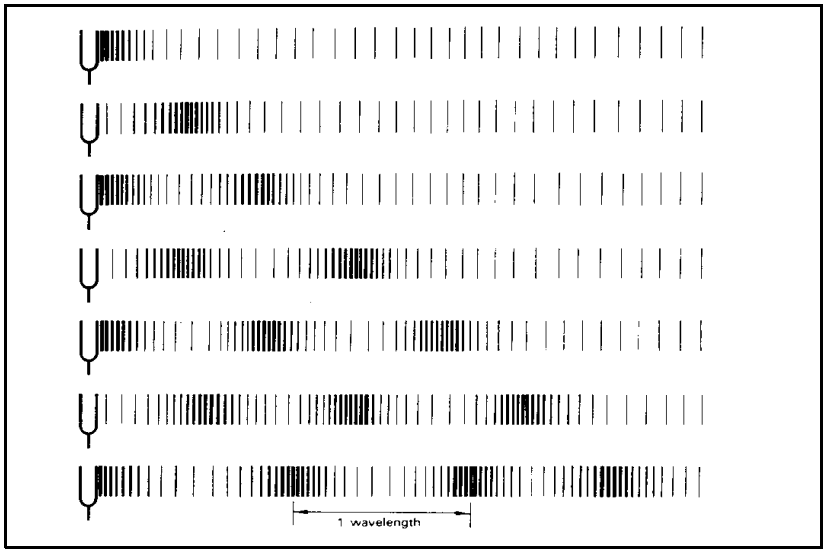
Examples of illustrations may include:
- ***"Slinky" waves*** - transverse and/or longitudinal (see PS-7.2). A wave in a "slinky" spring illustrates a mechanical disturbance caused by a force displacing one of the spring coils.



  - The energy of a wave in a "slinky" spring will pass from the point on the spring where a coil has been displaced to the end of the slinky.
  - The medium consists of the slinky coils.
  - The coils either move back and forth parallel to the length of the spring, or back and forth perpendicular to the length of the spring

- After the wave passes, the coils return to approximately the position where they were before the wave passed.

- ***Sound waves:***



The energy of the wave transmits from the tuning fork out in all directions. The shape of the wave will approximate the shape of concentric spheres.

- A sound wave requires a medium through which it travels.
- A sound wave is a longitudinal mechanical disturbance caused by a force displacing molecules in the medium through which it passes.
- A sound wave's energy travels out in all directions from a vibrating object.
- A sound wave travels through the medium. The particles of the medium remain where they were originally, but the wave energy moves from one place to another.
  - The particles of the medium move back and forth, parallel to the direction of the wave.
  - After a sound wave passes, the particles of the medium continue moving in approximately the same area where they were before the wave passed.

- ***Light waves***
  - Light waves do not need a medium through which to travel.
  - Light waves are transverse waves.
  - Light waves (or other electromagnetic waves) are energy that can be transmitted without mechanical disturbance of the particles of a medium
  - Light waves (and other electromagnetic waves) travel in straight lines in all directions from the source of the light as long as the medium does not change.
  - Light waves can transmit energy through empty space as from the Sun or stars.
  - The energy of the light wave travels from one place to another, but the particles of the medium, if there is one, remain in approximately the same area where they were before the wave passed.

Nature and Properties of Waves

PS-6 The student will demonstrate an understanding of the nature and properties of mechanical and electromagnetic waves.

Students should understand that all waves transfer energy from place to place. If the wave moves though a medium, the particles of the medium can be displaced in a variety of ways (such as parallel or perpendicular to the wave motion), but they are not transported with the energy of the wave.

Assessment Guidelines:

The objective of this indicator is to *illustrate* ways that the energy of waves is transferred, therefore, the primary focus of assessment should be to find specific illustrations (drawings, diagrams, or word descriptions) or use illustrations that show that the energy is being transferred in a variety of waves, transverse and longitudinal/compressional, and how the transfer of energy is different from the displacement of particles in the medium.

In addition to *illustrate*, students should be able to

- *Identify* transverse and longitudinal waves from illustrations;
- *Compare* transverse and longitudinal wave particle motion and energy transfer direction;
- *Summarize* the characteristics of longitudinal/transverse waves.
- *Exemplify* transverse and longitudinal waves.